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Indiana Plant Diseases in 1905.

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Indiana Plant Diseases in 1905.

By FRANK D. KERN.

The following resume of plant diseases in Indiana in 1905 is compiled chiefly from reports by correspondents made in response to a circular letter sent out by the Botanical Department. This has been supplemented by information gained from letters stating losses and inquiring for remedies, and from observations of the officers of the Experiment Station. The co-operation of the correspondents, who have furnished the principal basis for the estimation of losses and distribution, is most gratefully acknowledged.

This summary indicates the prevalence of the more important diseases of cultivated plants occurring in the State, and estimates the extent of injury as compared with the previous season, whenever possible. In 1904 the first systematic attempt was made to determine damages from such diseases, when a circular letter similar to that employed in 1905 was sent out to farmers, orchardists and gardeners over the state. The results, together with those obtained in 1905, have been most gratifying. It is hoped to make this an annual feature, and any assistance from those interested in agricultural, horticultural, garden, or ornamental plants, will be greatly appreciated.

In addition to the statement of facts regarding the prevalence and distribution, a paragraph has been inserted under each disease, setting forth briefly the information which is at hand concerning remedies, preventives, methods of combating, and explanation of conditions which render crops less susceptible. Great losses have occurred which might have been avoided to some extent, if not entirely, and it will be the aim in the following pages to treat of the means whereby this can be done, after having pointed out the economical importance. Believing that no crop is so large that any of it can profitably be wasted, it seems well to call attention to methods that can be successfully applied to minimize losses. In many instances there is little that can be offered at present, but when

the cultivator understands conditions which are favorable and unfavorable to the diseases, and will combine his efforts with those who are making special investigations, there is hope that the ravages may be reduced instead of allowing the destruction to continue indefinitely.

The diseases discussed are chiefly those caused by *fungi*, rather than mechanical or insect injuries, or disturbances due to unfavorable natural surroundings. Spores of a fungus are comparable to the seeds of a flowering plant and are its chief means of reproduction. It is to kill the spores, and thus prevent the spread of a fungus, for which fungicides are applied. For the sake of ready reference an account of the preparation of the fungicides, or spraying mixtures mentioned, has been appended.

The various crops are taken up separately and under each are listed the diseases to be discussed. In some cases where the same disease occurs on two crops only one discussion of the methods of control will be made, that being the first instance where it is mentioned, with references to that account in the following instances.

ORCHARD FRUITS.

Apple.—*Apple rot*, sometimes known as bitter or ripe rot, was prevalent and destructive in the central and southern portions of the state, where in some instances it is responsible for losses varying from one-fourth to one-half of the crop. It was more prevalent than in 1904 owing, perhaps, to more favorable weather conditions.

Since the disease spreads in the growing season chiefly by means of spores produced on the surface of the affected spots, all decayed fruit should be removed and disposed of. Twigs with cankers should be pruned away, as it is here that the spores of the fungus live over winter and give the rot a start in the spring. Spraying with bordeaux mixture in the winter and throughout the spring and summer prevents the spread and growth of the rot. After the fruit has commenced to ripen it is suggested that ammoniacal copper carbonate be used for the spraying, as it is not as liable to discolor the fruit as is the bordeaux.

Scab was unusually abundant and in unsprayed orchards caused much damage to the fruit crop. Spraying was not as effective as usual owing to the excessive rainfall at the time when the spraying should be applied.

A strong copper sulphate spray is recommended for application before the opening of the buds, to be followed by bordeaux just before and again after blossoming, with later sprayings at intervals of two or three weeks. Some varieties are less susceptible to this disease and much has been done to prevent losses by the selection of the resistant ones.

Blight, known also as twig blight and fire blight, was reported from various sections, but was less injurious than usual.

This is a bacterial disease for which no successful remedy is known. The only thing that can be done is to cut away the blighted limbs six inches to a foot below where the bark has turned brown. Apple orchardists will find it to their advantage to select resistant varieties and to remove pear trees which are of little value.

Pear.—*Blight* was quite generally prevalent over the state, but was not reported as destructive as in the previous season.

This is caused by the same bacteria as twig blight in apples, and the same method of cutting away the affected parts is to be practiced. Spraying is of uncertain value, and has rarely been sufficiently beneficial to warrant the advocacy of its use.

Quince.—*Black rot* was reported from the southern part of the state only, where in some instances it was responsible for considerable injury to the ripening fruit.

The apple and pear are other hosts for this fungus. To combat the disease all dead limbs and twigs are pruned away, cankered areas scraped and painted, and the same general method of spraying followed out as described above for apple scab.

Blight was also prevalent, but not unusually destructive. It is the same as twig and pear blight.

Peach.—*Yellows* has increased in its distribution over the state, though some localities report less injury than usual from this source.

Prompt measures to get rid of all affected trees as soon as found should aid in combating this disease.

Leaf curl was quite as prevalent as usual, the results of spraying seeming uncertain.

There is no remedy after the leaves have begun to curl and turn red, but spraying with bordeaux in the early spring when the buds begin to swell should prove an efficient preventive. In wet seasons a second spraying may be necessary after the blossoming period. Dilute bordeaux should be used to prevent possibility of injury to the foliage from the stronger mixture.

Brown rot is reported from some southern counties to have caused a loss of one-fourth of the crop.

There is little that can be done to avoid this disease except to pick and destroy all rotten fruit, and to remove all infected dried specimens from the trees and ground. The mummied fruits harbor spores and would tend to hang on the trees over winter, thereby giving the fungus a start the following season.

Plum.—*Black Knot* was responsible for considerable injury in some localities.

To prevent the fungus from spreading, the infected portions should be removed and burned in early spring. Cut ends of branches should be painted to prevent exposure.

Brown rot occurred chiefly in the central and southern counties, where in many instances it caused losses varying from 5 to 20 per cent.

This is a serious trouble. Regarding its control nothing can be said in addition to that given under the same disease of the peach.

SMALL FRUITS.

Blackberry.—*Crown gall* on the underground portions occurred in the state. There is no evidence concerning its abundance or extent of injury.

Diseased plants should be dug up and burned. Infested stock

ought never to be used for transplanting. Some queries on this point have been received.

Raspberry.—*Anthracnose* was reported from the northern part of the state first, with scattering reports from the central and southern parts.

This usually occurs only on the stems, where it produces whitish spots with purple margins. Affected canes should be carefully cut away at pruning time, and if the new canes become much diseased after they have started, the worst should be removed. Bordeaux mixture is used for a spray before the buds swell. If this does not check the spread of the disease, the spraying process may be repeated after the leaves develop, but to be effective especial care must be taken to get the spray on the young canes.

FIELD, GARDEN AND GREENHOUSE VEGETABLES.

Asparagus.—*Rust* occurred sufficiently to receive mention from some localities.

Little success has ever been attained in combating this disease. It is economical to destroy entirely the worst infected plants. All infected parts of plants should be collected in the fall and burned so as to destroy as many as possible of the spores which would give the rust a start the following season. Ordinary spraying mixtures seem to have little effect on the spread of the disease. Resin Bordeaux has been reported as partially effective, but is troublesome and expensive. Sulphur has been used with success in California recently.

Cabbage.—*Rot*, or what is more commonly known as *black rot*, occurred to such an extent in some localities that practically the whole crop was lost.

This is a bacterial disease which seems to show its effects rather rapidly. One day the plant will seem to be growing well, while in a day or two when the first sign of trouble is noticed, the whole head will be rotted. The bacteria first affect the lower leaves, turning the veins black, spreading from them to the stem, and from there

through the whole head. There is no remedy, but prompt removal and destruction of diseased plants will aid in checking the spread of the disease to other plants. The bacteria live over in the soil, but rotation of crops will aid in ridding the soil from them. After the disease has once started in a field, cabbage cannot safely be grown there the following season.

Musk Melon.—*Wilt* was the cause of injury to this crop in central and southern localities, some reports indicating considerable destruction.

A *leaf blight*, doubtless also caused by bacteria seems to have occurred both in conjunction with the wilt and independently.

Like other bacterial diseases these are hard to control. There is little evidence to show that spraying has been of any value. Removal of wilted vines, and an attempt to get rid of insects, which are said to distribute the bacteria, should be of some service in preventing the spread of the disease. Rotation of crops is undoubtedly a good thing, as there is always a possibility of bacteria living over in the soil.

Lettuce.—Injury to the growing of this crop under glass was reported from Muncie, Delaware County.

The exact cause of the trouble was not determined. Roots of diseased plants which were sent to the Station showed a peculiar yellow discoloration. Similar cases have been reported from other places in the state in previous seasons, except that the yellow spots have usually appeared on the leaves and portions above ground rather than on the roots. The trouble has occurred on outdoor plants as well as those grown under glass.

The affected areas have a bright yellow color and the surface tissues are slightly collapsed, but there is no evidence that either effect is due to fungus or insect work. Some of the roots showed tubercle-like distortions, but it is believed that these swellings had no connection with the yellow spotting.

No method of treatment was suggested, but Mr. J. W. Marsh, of Muncie, Ind., in whose greenhouses the trouble occurred, has the following to say regarding a method which proved successful in

combating the disease: "Since cutting off the affected crop I dug up and destroyed the roots. Then a mixture of a half bushel of pulverized charcoal and eight pounds of flowers of sulphur was worked into the soil of a bed of 640 sq. ft. It was a success. I have grown one fine crop and another is growing and doing well."

Potato.—*Scab* appears to have occurred quite generally all over the state, though the estimates concerning the extent of injury indicate that it is decreasing.

This is one of the few diseases which has practically a complete remedy. The formalin treatment of the seed potatoes first suggested by this Station has given excellent results.

The method is to immerse the seed tubers for two hours in a solution of the strength of one pound for formalin* to twenty-five gallons of water. If the potatoes are not much sprouted a longer soaking is advantageous. After treatment the potatoes are cut and planted as usual, either at once or after a time.

A fuller account of this remedy for potato scab may be found on p. 43, Bulletin 77, of this Station.

Tomato.—*Rot* seems to have been less prevalent than usual. In most instances it affected the early varieties most seriously.

There are a number of fungous diseases causing injury, both to foliage and fruit of the tomato. It is believed that bordeaux mixture will successfully check the growth of the fungus, which is chiefly responsible for the rot as well as a number of the other fungous diseases, in Indiana. The first spraying should be given when the flower buds open and should be repeated at intervals of about two weeks. In order to get good results the spraying must be thoroughly done. It has been found that a little extra lime in the mixture causes it to stick better. Ammoniacal copper carbonate may be substituted for the bordeaux when the fruit begins to ripen. This is especially recommended if the fruit is grown for market. Bordeaux does not injure the fruit for house use, but disfigures it and makes it less valuable for commercial purposes.

*See note on formalin in account of *Fungicides and Spraying mixtures*, p. 134.

Spraying will not only be useful toward checking diseases, but will also improve the quality of the crops. The spraying process requires but little time, labor, or expense, and is not something feasible only on a large scale with costly apparatus. A foot pump, with a short hose and a fine spray nozzle, and a large pail are all that is necessary for the garden crops and one season's results will more than repay the entire outlay.

CEREAL CROPS.

Oats.—*Rust* was reported chiefly from the southern counties where it began to show before harvest. There was doubtless both black stem rust and the genuine oat rust which affects only the leaves. Both occur on this host, and it is impossible to distinguish between them without examining material. But little injury is reported from the southern part and observations in the northern part go to show that the crop was unusually free from rust.

Smut occurred about as usual. Estimates as to the per cent. of crop injured vary from 5 to 10 per cent. This is an instance where the amount of damage is invariably under-estimated rather than over-estimated, the reason being that smutted stalks are usually broken or are shorter than normal ones and hence are overlooked. Exact methods of estimation devised by this station (see Bulletin No. 103), go to show that ordinary estimates must be doubled in order to approach the actual conditions.

The method of treating the seed with formalin, as described in Bulletins 77, 87 and 103 of this Station, is cheap, simple and uniformly successful. The seed oats are sprinkled until thoroughly damp with a solution, made by adding one pound of formalin* to 50 gallons of water. They are then shoveled into a pile, covered, and allowed to stand for two hours or more, after which they are ready to sow or to be dried and kept for later sowing. If care be taken to store clean seed in sacks or bins which have been disinfected with formalin, the resulting crops will be very free from smut.

*See note on *formalin* in account of *Fungicides and Spraying mixtures*, p. 134.

Wheat.—Rust caused but slight damage compared with the season of 1904. Most of the winter wheat matured and was harvested before the rust became at all noticeable or destructive. There occurred both the *stem* rust and the *leaf* rust, which are two distinct species of fungi. The *stem* rust is what is commonly called *black* rust, though it is not black throughout the season, the black color being characteristic of the last of the season only. It generally confines its activity to the stem, however, and owing to its vigorous manner of attacking the tissues and taking up nourishment is the one to which practically all the losses are due.

There is at present no way of ministering to crops affected by rust diseases, but there is such a thing as putting the crops in a state that they may minister to themselves. Among the things to be suggested are breeding of varieties, drainage of fields, and selection of seed. Varieties which mature early are less liable to attacks of rust than later ones, because they may mature before the rust reaches its worst stage. There is a great variation in the resistance among different varieties; the Durum wheats introduced by the U. S. Department of Agriculture have proven exceptionally resistant, though there is considerable variation even within this group. Well drained fields grow crops that are more resistant because the tissues are firmer and less succulent than when there is too much water in the soil. If volunteer growths are kept down the fungus will not have as fine an opportunity for living through the unfavorable winter season, that is, the spores which directly infect the grain plants will not have as good an opportunity of being carried through. Warm, moist weather is not the cause of rust, but is favorable to its growth. However, since the weather cannot be controlled, little can be done with this point except to regard it as an interesting bit of information. Straw from a badly rusted crop has been found by the Minnesota Station and some of the Canadian Experimental Farms to contain a higher percentage of nutritious materials than normal straw. This is because the action of the fungus arrests the nourishment which would go to the kernels and causes it to remain in the stems. If so it is needless to discard badly rusted straw, for it may be profitably used for feeding. It is uncertain how much may

be gained toward rust resistance by the selection of seed, but the matter of selecting good seed is an important one and should be practiced for other reasons as well. Kernels growing on badly rusted stalks will nearly always be lighter and can be separated out by a thorough fanning.

Smuts were about as prevalent as usual. The stinking smut was perhaps more abundant than in 1904.

The stinking smut, which fills the kernels with a brown greasy powder and gives off an offensive odor when crushed, is caused by a fungus similar to the one causing oat smut and can be prevented by the same treatment, which is described under *Smut* of Oats. There is no successful treatment for *loose smut*, the sort which blows away, leaving a bare spike at harvest time.

Scab was more abundant than usual, in some instances heavy losses being reported.

This trouble is produced by a mold-like fungus, which causes the heads to appear prematurely ripe. A description of the action of this disease was given in Bulletin 36 of this Station. But little can be added to the account given there. No remedies or preventives have been found. Late sown and poorly grown wheats are most susceptible, while the early varieties grown on well drained and cultivated soil seem less liable to injury from this source.

Corn.—*Smut* occurred about as usual over most of the state, with especially bad losses in a few localities.

No successful method of combating this disease has ever been tried. The only thing that can be done is to go through the field two or three times during the growing season and remove the smutted ears and tassels. These masses when collected should be completely destroyed by burning or boiling them. The effects of such a course may not be apparent at once, but when diligently pursued must certainly lessen the amount of smut in later crops.

FUNGICIDES AND SPRAYING MIXTURES.

Bordeaux Mixture.

Copper Sulphate,	5 pounds.
Lime,	5 pounds.
Water,	50 gallons.

The copper sulphate and lime are dissolved separately and combined in dilute solution. The copper sulphate may be dissolved in hot water or by suspending it in cold water in a coarse bag and then diluted to about 20 gallons. If fresh stone lime is employed it is slaked and diluted to about 10 gallons. These two solutions are now turned together, thoroughly mixed and diluted up to 50 gallons. Stock solutions of either copper sulphate or lime of the strength of 1 lb. to 1 gal. water may be kept on hand. There are on the market some "new process" or prepared limes which have been used by many growers with excellent success and less trouble than the ordinary stone lime. The cost is slightly greater, but they are entirely available and stir into water more readily. A rather full account of the making of bordeaux with "new process" limes is given in Bulletin 235, of the Cornell Station, by M. V. Slingerland.

Dilute Bordeaux Mixture.—Made by using one-half as much copper sulphate and lime as in the ordinary mixture.

Ammoniacal Copper Carbonate.

Copper Carbonate,	4 ounces.
Ammonia,	3 pints.
Water,	50 gallons.

Dissolve the copper carbonate in the ammonia and dilute to final volume.

Copper Sulphate (strong).

Copper Sulphate,	3-4 pounds.
Water,	50 gallons.

Prepared in same manner as described under bordeaux mixture, and in this strength to be used only as a winter spray.

Formalin.

For Grain.

Formalin,
Water,

1 pound.
50 gallons.

For Potatoes.

Formalin,
Water,

1 pound.
25 gallons.

Formaldehyde is the chemical name for formalin, and is occasionally used in the trade. Forty per cent. formalin is standard strength and is the one referred to in the above formulas.

